ANL/EVS/AGEM/TR-05-02

2005 Cross Section Analysis and Recommendations for Further Studies at Everest, Kansas

prepared by
Environmental Science Division
Argonne National Laboratory

Argonne National Laboratory is managed by
The University of Chicago for the U. S. Department of Energy

United States Department of Agriculture
Work sponsored by Commodity Credit Corporation,
United States Department of Agriculture

ANL/EVS/AGEM/TR-05-02

2005 Cross Section Analysis and Recommendations for Further Studies at Everest, Kansas

by
Applied Geosciences and Environmental Management Section
Environmental Science Division, Argonne National Laboratory

January 2006

Contents

Figures

Notation

CAS	Corrective Action Study
CCC	Commodity Credit Corporation
CPT	cone penetrometer
ft	foot (feet)
gal	gallon(s)
gpm	gallon(s) per minute
hr	hour(s)
in.	inch(es)
KDHE	Kansas Department of Health and Environment
USDA	U.S. Department of Agriculture

2005 Cross Section Analysis and Recommendations for Further Studies at Everest, Kansas

1 Introduction

On September 8-9, 2005, representatives of the Kansas Department of Health and Environment (KDHE), the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA), and Argonne National Laboratory met at the KDHE's offices in Topeka to review the status of the CCC/USDA's environmental activities in Kansas. A key CCC/USDA goal for this meeting was to discuss the recent (Phase III) environmental studies performed by Argonne at Everest, Kansas, and to obtain KDHE input on the selection of possible remedial approaches to be examined as part of the Corrective Action Study (CAS) for this site. Argonne distributed a brief *Scoping Memo* (Argonne 2005) to the CCC/USDA and the KDHE before the meeting to facilitate the intended pre-CAS discussions.

As a result of the September meeting, the KDHE recommended several additional activities for the Everest site, for further assistance in identifying and evaluating remedial alternatives for the CAS. The requested actions include the following:

- Construction of one or more additional, strategically located interpretive cross sections to improve the depiction of the hydrogeologic characteristics affecting groundwater and contaminant movement along the apparent main plume migration pathway to the north-northwest of the former CCC/USDA facility.

- Development of technical recommendations for a stepwise pumping study of the Everest aquifer unit in the area near and to the north of the Nigh property.

- Identification of potential locations for several additional monitoring wells, to better constrain the apparent western and northwestern margins of the existing groundwater plume.

This report presents an update on efforts of the CCC/USDA and Argonne to address the KDHE concerns, and it proposes several additional actions for consideration.

2 Supplemental Cross Sections

Two new hydrogeologic cross sections have been generated for the Everest site. These cross sections are based on subsurface data (core samples and descriptions, cone penetrometer [CPT] geomechanical electronic logs, and geochemical sampling results) obtained during Phase I, Phase II, and Phase III studies at Everest (Argonne 2001, 2003, 2004). The locations of the new cross sections are shown in Figure 2.1. The lithologies represented along the lines of section were, to the maximum extent possible, determined from descriptions of core materials collected at the chosen boring locations. Where core data were not available, qualitative correlations based on the comparison of CPT electronic log responses in cored and uncored intervals were used as the basis for the lithologic interpretations.

Preliminary draft versions of these cross sections were discussed with Christopher Carey of the KDHE at Argonne's Lincoln, Nebraska, office on September 29, 2005, and copies of the drafts were sent to the KDHE on October 3, 2005. The core and CPT electronic logs for all of the borings included in the new sections are in the Everest Phase I, Phase II, and Phase III investigation reports (Argonne 2001, 2003, 2004). Additional copies of these reports are available upon request.

Section D-D′ (Figure 2.2) extends north-northwestward from the former CCC/USDA facility; it runs westward beneath and to the west of the Nigh property. Section D-D′ follows the approximate axis of maximum carbon tetrachloride concentrations in the groundwater plume. Section E-E′ (Figure 2.3) extends from south to north, running roughly parallel to Prairie Road where the main body of the plume passes westward beneath Prairie Road and the Nigh property.

As noted in previous studies, the migration of groundwater and carbon tetrachloride at the Everest site occurs within a sedimentary sequence that is dominated by variably silty to sandy clay till. In constructing the new sections, an effort was made to illustrate the relative distribution of intervals that contain predominantly clayey till with minor silt- and sand-sized materials, versus zones that contain a higher proportion of coarser materials (sand and gravel) within the till. Detailed review of the core logs indicated that these coarser sediments occur primarily as either disseminated grains within the clay till matrix or as thin, poorly sorted stringers, lenses, and partings. Predominantly coarser-grained intervals ~0.5 ft or more in thickness that could be identified from the logs are represented discretely in the sections; however, the depiction of these intervals is still somewhat schematic.

Figures 2.2 and 2.3 indicate that the highest carbon tetrachloride concentrations within the aquifer unit generally occur in the lithologically variable but relatively coarser-grained upper portions of the unit. Groundwater sampling for volatile organic compounds in the deeper, relatively more clayey lower portions of the aquifer unit was limited during Argonne's earlier studies because of an observed lack of water saturation in cores from much of the deeper section. The new cross sections illustrate that contaminant migration might occur largely via a network of sandy and gravelly lenses and stringers that become thinner and more discontinuous westward, in the vicinity of the Nigh property. The presence of elevated contaminant levels does not appear to be correlated, however, with the overall thickness of the aquifer unit. Figure 2.2 demonstrates that the high concentrations of carbon tetrachloride identified at borings SB33 (location of the highest concentration detected to date in groundwater) and SB39 occur along the flanks of a "structural high" on the underlying silt/clay, where the net thickness of the saturated till sequence is less than 5 ft.

In the portion of the study area generally east of Prairie Road and the Nigh property, a variably thick, often highly carbonate-cemented unit of clayey sand to sandy clay (identified as unit 3A in Argonne's earlier reports) overlies the aquifer unit. Across much of this area, coring of the clayey sand indicated that it is "dry" to variably saturated; it therefore acts to confine the aquifer unit at least partially. At locations where sufficient permeability exists to permit saturated conditions within unit 3A (SB29 and SB02 in Figure 2.2; SB21, SB42, SB44, and SB66 in Figure 2.3), this interval might also provide a pathway for groundwater and contaminant migration. Unit 3A appears to be absent to the north of 120th Street and the Nigh property (Figures 2.1 and 2.3). West of the Nigh property, these sands appear to become cleaner, more permeable, and more consistently saturated (Figure 2.2).

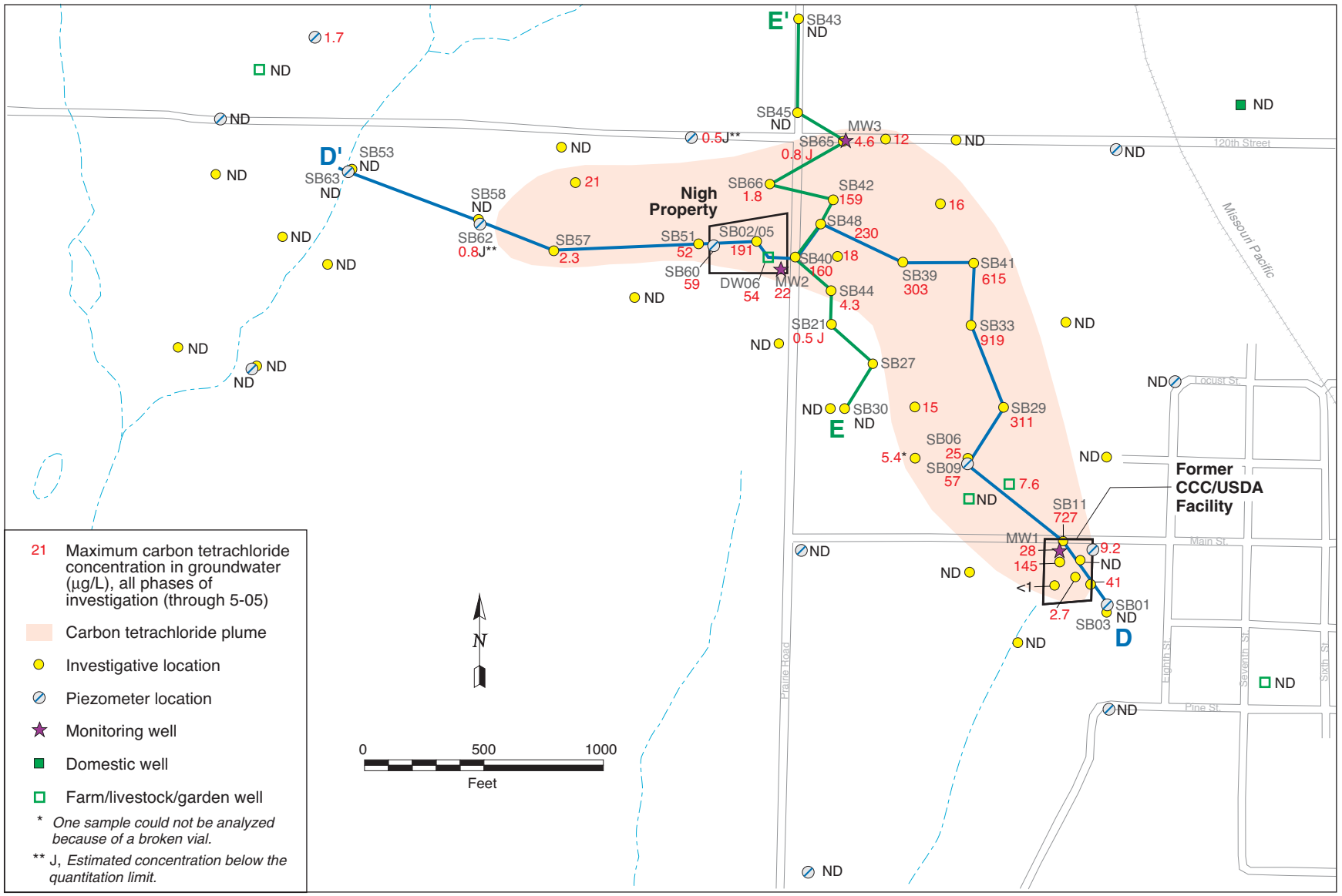

FIGURE 2.1 Locations of interpretive hydrogeologic cross sections D–D′ and E–E′ in the western part of Everest.

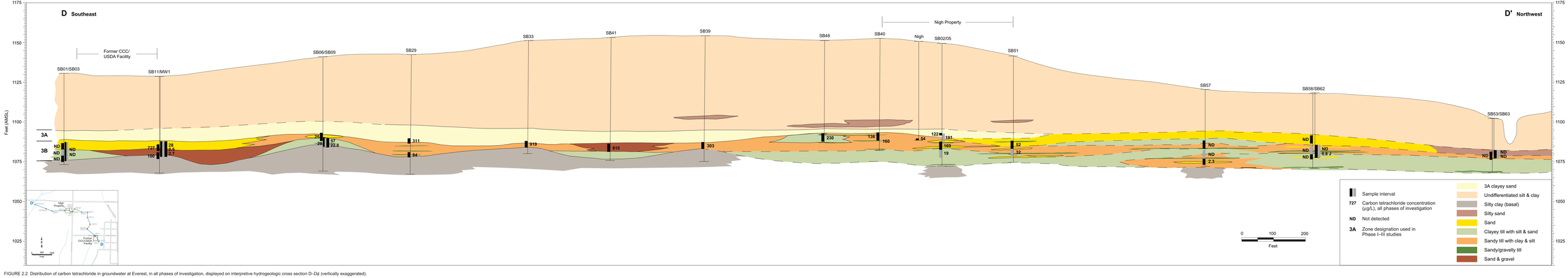

FIGURE 2.2 Distribution of carbon tetrachloride in groundwater at Everest, in all phases of investigation, displayed on interpretive hydrogeologic cross section D–D′ (vertically exaggerated).

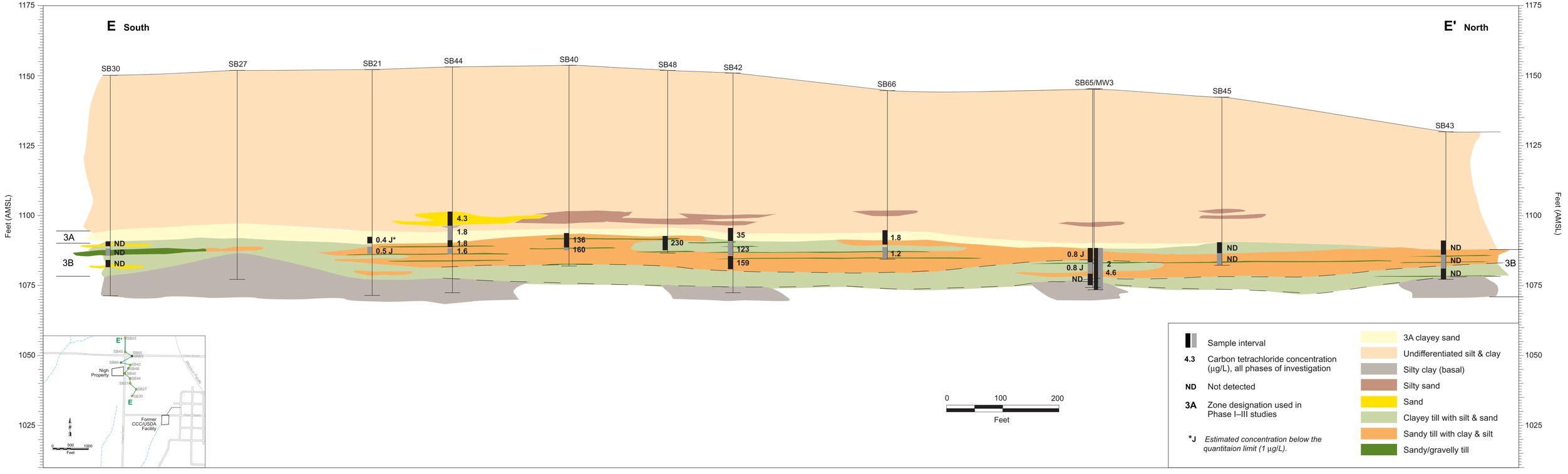

FIGURE 2.3 Distribution of carbon tetrachloride in groundwater at Everest, in all phases of investigation, displayed on interpretive hydrogeologic cross section E–E¢ (vertically exaggerated).

3 Proposed Strategy for Well Testing near the Nigh Property

The individual boring logs and cross sections described above indicate that (1) the development of the more permeable intervals within the Everest aquifer unit in the vicinity of the Nigh property is relatively sparse and (2) these intervals are likely to be thin and laterally discontinuous. These observations are qualitatively consistent with the results obtained by Argonne during testing of monitoring well MW2, located at the southeast corner of the Nigh property.

3.1 Previous Well Testing on the Nigh Property

Well MW2 was installed for possible use as a production well for aquifer testing during the Everest Phase III investigation. The well is 4 in. in diameter and 79 ft deep, and it is equipped with a 20-ft, wire-wrapped stainless steel screen that fully penetrates the aquifer unit. Initial development and test pumping of MW2 indicated that flow rates as low as approximately 0.8 gpm could not be maintained at this location without risk of dewatering of the well and that the radius of influence of pumping at these low rates was extremely limited (< 21 ft from the well). These results were transmitted to the CCC/USDA and the KDHE during the Phase III investigation, and with their concurrence the planned pumping test at MW2 was abandoned.

The interpreted characteristics of the aquifer unit near the Nigh property are also in keeping with anecdotal information concerning the private well on this property (no longer used for domestic purposes). The Nigh well is a large-diameter, brick-lined well approximately 63 ft deep that penetrates the upper (contaminated) portion of the aquifer unit. Argonne estimates that under the range of groundwater level conditions observed at this location, the Nigh well typically has a casing storage volume of 400–900 gal. Mr. Nigh has informally mentioned to Argonne staff that when this well was previously used for lawn watering, at least 2–3 days of inactivity were required between watering events for adequate recovery of the water level. These observations again suggest a very low recharge rate of groundwater to the well, consistent with the value < 1 gpm noted above.

3.2 Proposal for a Stepwise Pumping Study

In light of the above history, the CCC/USDA and Argonne are uncertain about the potential for successful pump testing of the Everest aquifer unit in the vicinity of the Nigh property at flow rates that might ultimately be suitable for restoration of the aquifer, as suggested by the KDHE during the September 2005 meeting. The CCC/USDA and Argonne therefore propose a stepwise aquifer testing program, to be implemented in cooperation with the KDHE.

3.2.1 Test Pumping of the Large-Diameter Nigh Well

To gain, in a time- and cost-effective manner, additional quantitative data that will assist in the evaluation of (1) the aquifer characteristics and (2) the potential design needs for a new test well or a future extraction well, the CCC/USDA and Argonne first recommend test pumping of the existing large-diameter Nigh well. Experiments will be conducted to determine the maximum expected sustainable flow rate from the well. If the resulting pumping rate is very low, a series of purge-and-recovery cycles will be performed to determine the rate of groundwater recharge to the well.

If a reasonable flow rate (preferably 2–3 gpm, with observed drawdown) can be obtained, a 24-hr constant-rate pumping test can be performed by using existing borings SB60, SB68, and MW2 (Figure 3.1) as drawdown observation points to evaluate the potential radius of influence of the pumping.

3.2.2 Design and Installation of a New Pumping Well

The results of the Nigh well testing proposed in Section 3.2.1 will be presented to the CCC/USDA and the KDHE for evaluation and discussion. If the project managers agree — on the basis of the results — that further testing of the aquifer along the plume migration pathway north-northeast of the Nigh property is warranted, Argonne will proceed with the design and installation of a new pumping well in consultation with the project managers.

Argonne has made preliminary inquiries regarding access to the property near former CPT borings SB40, SB42, and SB48 (east and northeast of the Nigh property; identified by the

KDHE at the September meeting as a potential target area for testing). These inquires suggest that the installation of a test well along the east shoulder of Prairie Road directly west of former CPT location SB48 (Figures 2.1 and 3.2) will be logistically possible and that the location will be suitable for the long-term siting of a monitoring or extraction well.

The new well will be developed, its expected production rate determined, and the results discussed with the CCC/USDA and KDHE project managers.

3.2.3 Installation of Temporary Observation Points

If the results of the well development proposed in Section 3.2.2 indicate that a reasonable production rate can be obtained, the CCC/USDA and Argonne will install a network of temporary observation points (piezometers constructed through use of the CPT) and conduct an extended (24 hr minimum) pumping test in consultation with the KDHE. A preliminary recommendation for the distribution of the observation points is shown in Figure 3.2. Argonne believes that the suggested observation points will (1) provide necessary information on the expected pumping radius of influence across the apparent migration pathway of the plume and (2) minimize intrusion and damage to the private agricultural fields adjacent to Prairie Road.

FIGURE 3.1 Locations of existing water level observation points SB60, SB68, and MW2, to be used during the proposed test pumping of the Nigh private well.

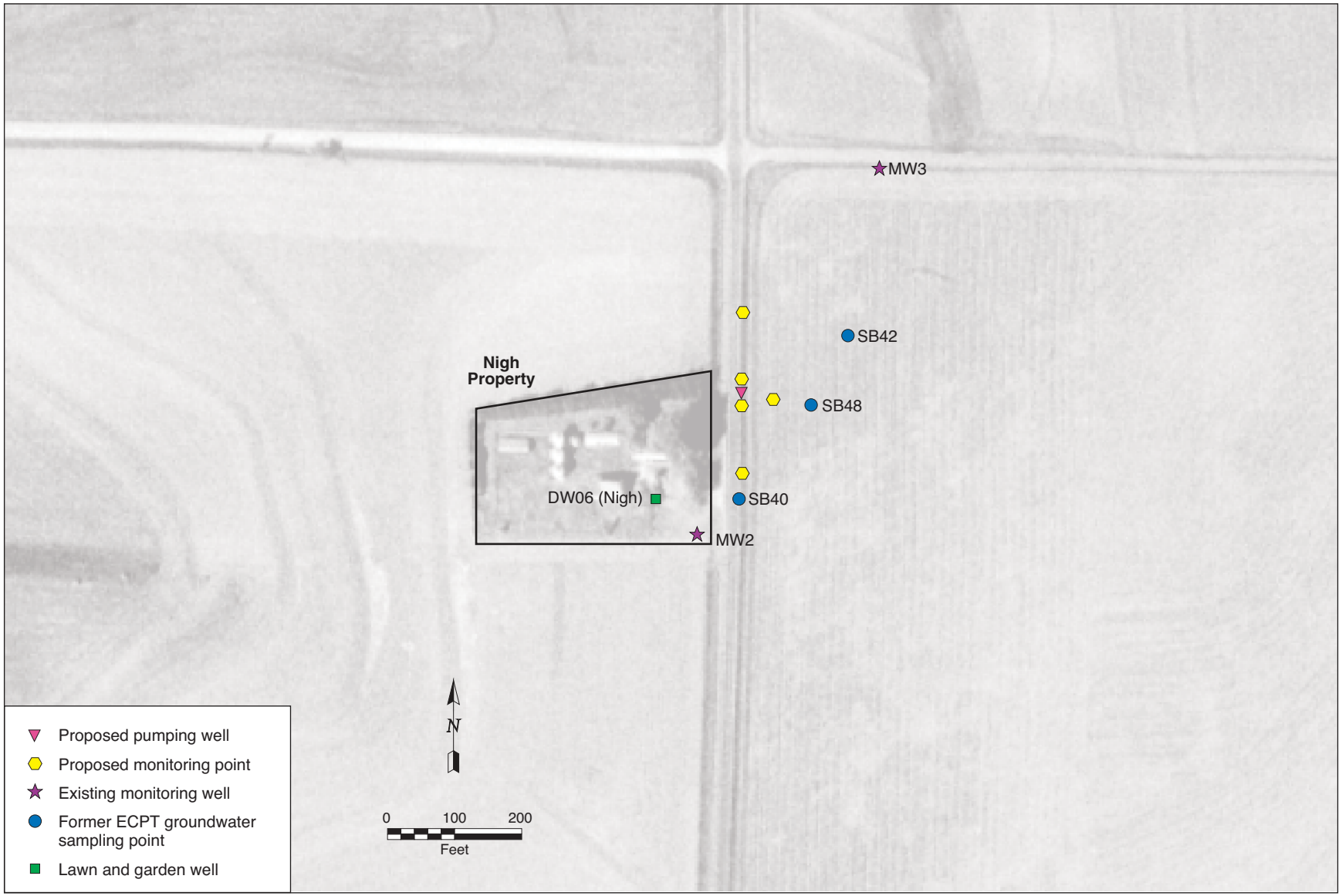

FIGURE 3.2 Proposed locations for a new pumping well and water level observation points (temporary piezometers to be installed with the CPT) for proposed aquifer testing along the plume migration pathway northeast of the Nigh property.

4 Proposed Strategy for the Installation of Additional Monitoring Wells

During the September 2005 meeting, the KDHE requested the installation of several additional permanent monitoring wells to constrain and monitor the potential migration of the northern margin of the carbon tetrachloride plume in greater detail, as well as to confirm that no westward expansion of the plume is occurring in the area south of the Nigh property. The general locations suggested by the KHDE for such wells were (1) in the northwestern portion of the study area, between existing monitoring points SB49 and SB77 (along 120th Street); (2) in the northern portion of the area, east of existing monitoring well MW3 (also along 120th Street); and (3) west and north of the former CCC/USDA facility, between existing monitoring wells SB16 and MW2 (along Prairie Road). To comply with this request, potential locations for three new monitoring wells (MW5, MW6, and MW4, respectively) are proposed in Figure 4.1.

The CCC/USDA and Argonne suggest, however, that the installation of any new permanent monitoring wells be deferred until the CAS evaluation process has been completed and a remedy has been selected for the Everest site. The monitoring locations requested by the KDHE in the September discussions appear to be targeted at tracking the potential evolution of the plume under the existing, ambient groundwater flow conditions. Our concern is that the implementation of certain remedies, such as a pump-and-treat strategy, could significantly alter the groundwater flow and contaminant migration patterns at the site and hence reduce the potential value of the suggested wells for long-term monitoring of aquifer restoration.

If the KDHE concludes that the requested monitoring wells will be beneficial to long-term observation of the site regardless of the remedial action ultimately implemented, the CCC/USDA and Argonne suggest that their installation be scheduled to coincide with potential installation of the pump test well (if required), to minimize the mobilizations of equipment required for the site.

The CCC/USDA and Argonne will use the CPT to collect groundwater samples at the proposed monitoring well locations if the CPT unit is mobilized to the site in preparation for pump testing. The results of the groundwater sampling will indicate whether contaminant migration has already occurred in the proposed locations.

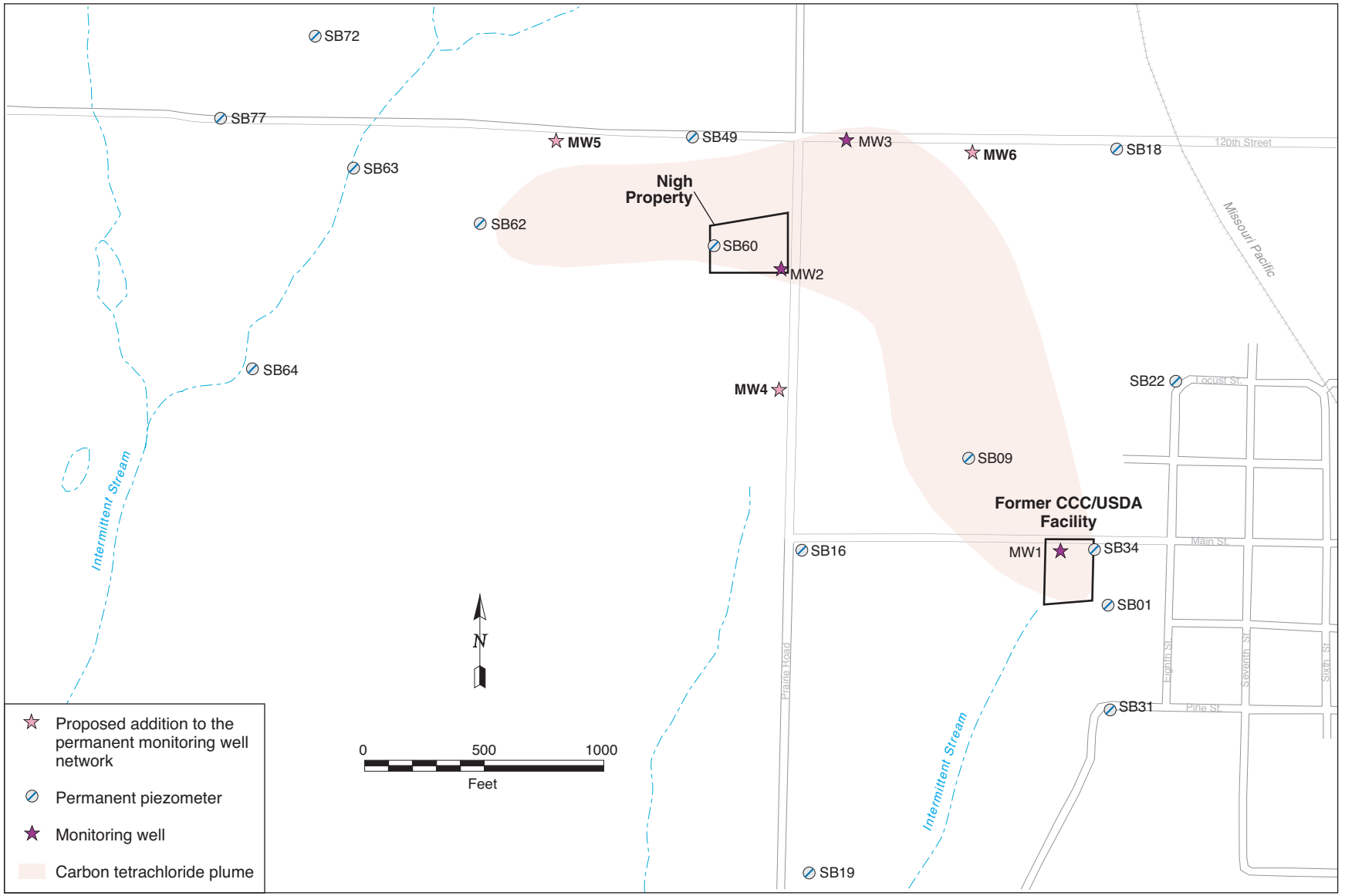

FIGURE 4.1 Locations proposed for the installation of new permanent monitoring wells at Everest.

5 References

Argonne, 2001, *Final Phase I Report and Phase II Work Plan: QuickSite® Investigation, Everest, Kansas*, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, by Argonne National Laboratory, Argonne, Illinois, August (revised March 2003).

Argonne, 2003, *Final Phase II Report: QuickSite® Investigation, Everest, Kansas*, ANL/ER/TR-03/003, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, by Argonne National Laboratory, Argonne, Illinois, September.

Argonne, 2004, *Draft Report: Phase III Targeted Investigation, Everest, Kansas*, ANL/ER/TR-04/004, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, by Argonne National Laboratory, Argonne, Illinois, September.

Argonne, 2005, *Scoping Memo for the Discussion of Potential Remedial Options for the Groundwater Contamination Site at Everest, Kansas*, ANL/ER/AGEM/CHRON-883, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, by Argonne National Laboratory, Argonne, Illinois, September 6.